

SUPERVISED CLOSED-LOOP FRACTURING

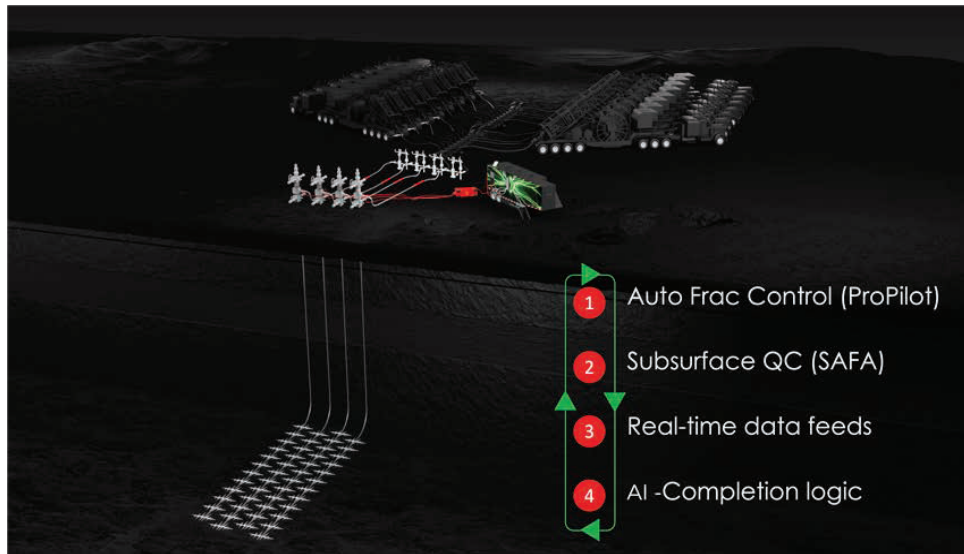
Adaptive Surface Control: AI-assisted recommendations applied by the operator with one touch.

HOW IT WORKS:

- **Measure What Matters:** The system tracks Perforation Efficiency, Flow Distribution (Uniformity Index), and Near-wellbore Friction during each stage.
- **Understand the Why:** Insights pinpoint what drives treating pressure changes, whether from friction, surface equipment, or perf behavior.
- **Inform Decisions:** Real-time recommendations guide engineers on the best next action.
- **Surface Automation:** automate rates, fluids, or chemicals adjustments, and even call stages early based on quantified evidence.
- **Verify Results Instantly:** Immediate feedback confirms whether adjustments achieved the desired outcome.

KEY CAPABILITIES

- **Real-time Subsurface Feedback:** Detects cluster activation, friction variation, and fluid
- **Adaptive Surface Control:** AI-assisted adjustments executed upon operator approval.
- **Stage-to-Stage Learning:** Continuously refines design live and from previous



System Overview

Supervised Closed Loop Fracturing (CLF) unites ProFrac ProPilot™ surface automation with Seismos SAFA™ acoustic subsurface measurements to form a closed-feedback control system for hydraulic stimulation. Unlike model-driven control systems that rely on predicted fracture behavior, this approach provides measured, physics-based feedback directly from the subsurface. The result is a fully auditable, real-time workflow that enhances stage consistency, minimizes waste, and improves fracture distribution efficiency.

Performance Metrics

Metric	Description	Typical Improvement
Uniformity Index (UI)	Balance of fluid volume distribution across clusters	+0.1 (≈ 15–30 %) uplift
Effective Energy	Ratio of effective energy to total surface energy	+10–25 %
Stage Variability	Consistency of fracture behavior across stages	–40–60 %
Fluid Utilization Efficiency	Productive barrels per effective fracture length	Up to 20 % reduction in waste
Response Latency	Time between detected deviation and control update	< 1 second



Field Example:

A 2024 Midland Basin pilot (6 wells, 40–120 bpm) demonstrated a 45% reduction in stage variability and a \$300k average NPV uplift per well through real-time rate reallocation.